

**THE TEST ANALYSIS RETRIEVAL SYSTEM (TARS)
MEETING THE CHALLENGES OF
THE NETWORK'S TEST PROCESSES**

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1.0 Summary

The Networks Systems Test Section (GSFC 531.4) is responsible for managing a variety of engineering and operational tests used to assess the status of the Network elements relative to readiness certification for new and ongoing mission support and for performance trending. To conduct analysis of data collected during these tests, to disseminate and share the information, and to catalog and create reports based on the analysis is currently a cumbersome and inefficient task due primarily to the manual handling of paper products and the inability to easily exchange information between the various Networks elements.

The Test Analysis and Retrieval System (TARS) is being implemented to promote concise data analysis, intelligible reporting of test results, to minimize test duplication by fostering a broad sharing of test data, and perhaps most importantly, to provide significantly improved response to the Network's internal and external customers. This paper outlines the intended application, architecture and benefits of the TARS.

2.0 Introduction

The Networks Test Section of the Telecommunication Systems Branch in the Goddard Space Flight Center's Networks Division manages the development and conduct of a variety of tests and simulation activities for the purpose of ensuring continuing compliance with all Networks internal and external, space and ground based interfaces. This responsibility also includes all Networks readiness activities for support of upcoming missions as well as routine characterization of systems for performance trending evaluations.

- The Challenge

The participants for the conduct of these test and simulation activities can vary from strictly on-site personnel such as for Station Readiness Tests, to a globally diverse team typically involved in network end-to-end tests. In all cases the Network's control point is the GSFC Network Control Center (NCC) staffed by a Test Director (TD) who manages the end-to-end coordination and test conduct. One of the TD's responsibilities is to generate a written test report which is supplemented by reports from each participating test element. Ideally, these various inputs are synthesized into a comprehensive set of data and conclusions in harmony with each participant's assessment. This, however is not always the case due to the cumbersome process of creating, collecting and summarizing various paper reports containing test results information.

During the planning phase for these tests there is rarely any research done to assess if data collected during previously run tests could apply to the test being planned to potentially negate the need for even running the test. This is largely because of the difficulties inherent in searching paper files for data which may or may not exist. Clearly significant amounts of valuable Networks resource time could be saved with the ability to utilize sets of test data to satisfy multiple needs.

- The Solution

The Test Analysis and Retrieval System (TARS) is being implemented to meet the challenges of the Network test processes. The purpose of the Test Analysis and Retrieval System (TARS) is to convert today's paper intensive data collection, archival and dissemination environment into a work station based electronic media system which will facilitate ease of access to test data for on-line analysis, trending, and report generation. Once the first phase of TARS is established locally at GSFC it is planned to be augmented to extend its availability to other Networks facilities involved with testing such as the White Sands Complex. A number of existing informational data bases will then be integrated with TARS to provide a comprehensive archive of data from, for example, TDRS satellite performance tests which are used for end-of-life trending forecasts.

3.0 The Test Analysis Retrieval System (TARS)

3.1 TARS Overview

TARS is a database driven system which stores and enables access to test data and results of various network testing. The system provides common access to a shared database and other software on a Netware fileserver. The objective of TARS is to convert the current paper intensive test data environment to an electronic system utilizing state-of-the-art 10Base-T Ethernet LAN technology and a relational database configuration which facilitates on-line sorting and searching of test data using keywords and relationships.

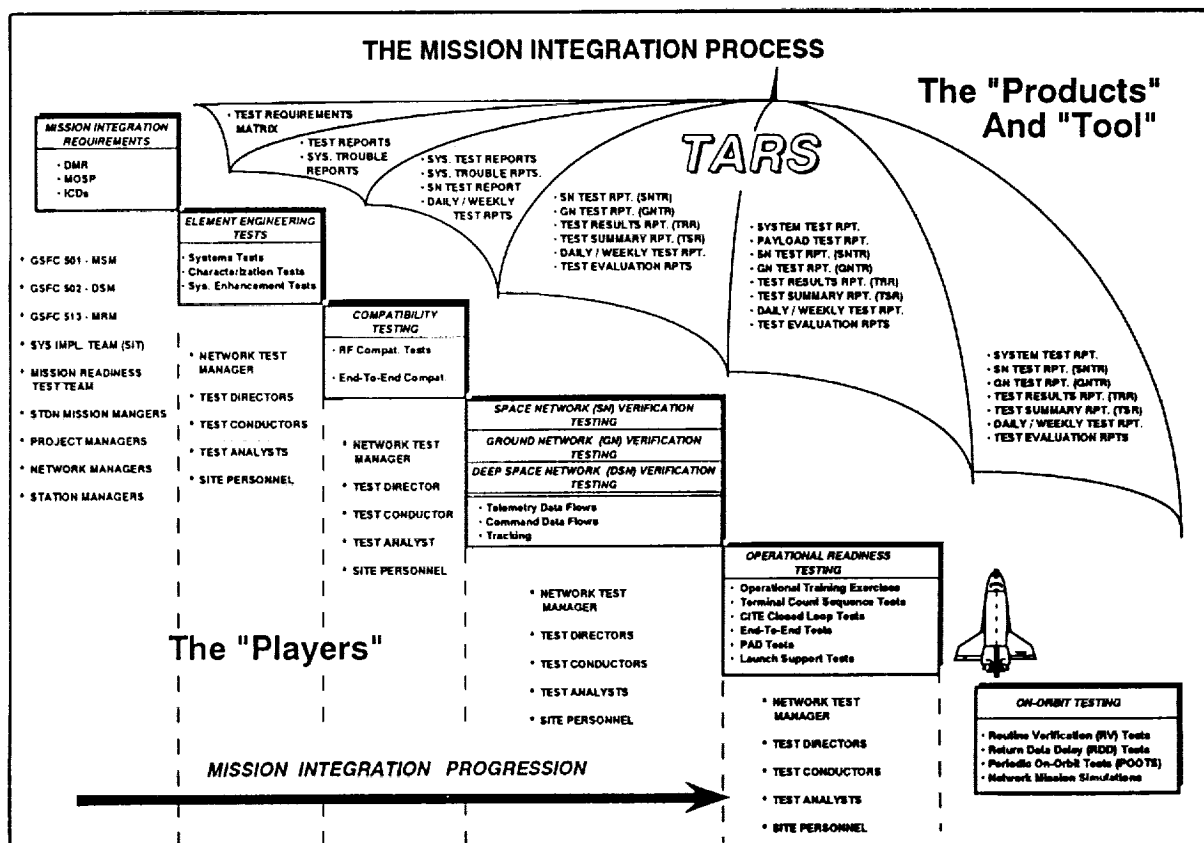
TARS is being developed by the Mission Operations and Data Systems Directorate's (MO&DSD's) Systems Engineering and Analysis Support (SEAS) contractors specifically for the Networks Test Section Code 531.4. The system is designed to comprise a collection of available Commercial-Off-The-Shelf (COTS) hardware and software with a minimum of specially designed software integrated into a system able to assemble and control the results of network test data. TARS will create test reports, provide system users with easy access to archived data, and perform analysis and comparisons of specific data types useful in assessing performance curves. A primary goal of the system implementors is to assure efficiency, effectiveness, and user friendliness for it's various users.

TARS consists of three major hardware components, the file server, work stations, and the LAN. TARS is a relational database driven system which will initially perform the five major functions of data collection, data storage, data manipulation, data distribution and data display. Additional TARS capabilities including assembly of characterization test data and plotting and graphing of engineering information in hard copy form are planned.

3.1.1 TARS Mission Integration Test Support

The TARS will support many facets of the GSFC MO&DSD network mission integration and testing efforts. Network mission integration is a progressive process of certifying that the network resources are ready and qualified to support a particular mission. Figure 3.1.1 depicts the mission integration chronology including the tests, activities, and users which TARS is designed to support.

FIGURE 3.1.1 TARS AND THE MISSION INTEGRATION PROCESS



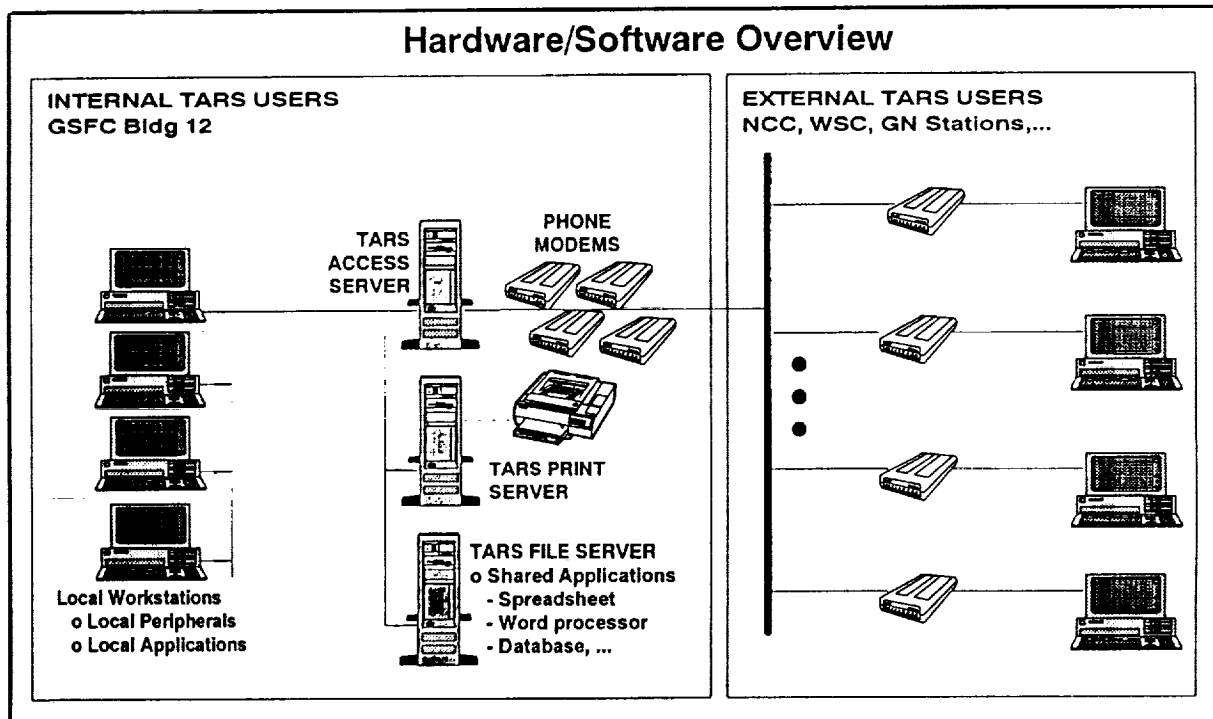
Network mission integration begins when network support and test requirements are levied on the Network by the projects, or mission managers. These requirements are managed and controlled by the MO&DSD Mission Support Mangers (MSMs), Mission Readiness Managers (MRMs) and the Data Systems Managers (DSMs). These requirements will be entered into the TARS database and matrixed to the corresponding test activities to assure test requirements traceability and consummation.

The primary function of TARS is in support of the mission integration and test processes. This process typically begins with element engineering testing, progressing to compatibility testing, ground and space network verification testing, operational readiness testing and training, and culminating with on-orbit testing. Throughout this mission integration "life cycle" the TARS allows common access to a shared data base and software on a network file server. Through an existing local area network, TARS is designed to archive and assemble the results of the test data, generate plotting information, and create graphics and text of the test data in a hard copy or screen format. TARS will enable historical test data retrieval (search and sort), test analysis, statistical comparisons, and data formatting for test technicians/ engineers, management and the space network users.

3.1.2 The TARS Users

TARS has potentially many users. These users can be classified as internal and external users. For the purpose of this paper the internal users are defined as on-site GSFC Building 12 test personnel who have access to TARS via the local area network and have direct on-line access to the TARS access server. The external users are those test personnel that are located off-site or outside of GSFC Building 12. Such external users include the NCC, and the SEAS and NMOS contractor facilities. The external users are planned to include off-site Network locations such as the White Sands Complex (WSC) and various Ground Network (GN) stations and potentially the Deep Space Network (DSN) stations. Details of the TARS user capabilities and potentials are described in the succeeding paragraphs. Figure 3.1.2 depicts the general TARS user support configuration.

FIGURE 3.1.2 TARS USER SUPPORT CONFIGURATION



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3.1.2.1 Internal User

The primary internal user of the TARS is the GSFC Mission Operations and Data Systems Directorate's Network Test Section. The TARS allows the Network Test Section personnel to archive test data and retrieve the data for analysis and reporting. TARS enables the Network Test Section personnel to review engineering test requests and compare them with archived data to assure that tests have not been previously performed and/or that the data is not currently available. If the testing involves a unique test scenario the system will provide data which assures that test plans and briefing messages will accomplish the desired results and can be coordinated with the WSC and other test participants.

- Network Test Manager (NTM)

The Network Test Manager (NTM), is the mission verification lead for Network Test Section. The NTM utilizes TARS to store and to trace network test requirements and to assure that those requirements are met either through analysis or testing. As tests are performed the NTM assures that all pertinent test data is gathered and archived in the TARS. The test data includes test characteristics, test article and spacecraft parameters, discriminators, and test issues and discrepancies. The NTM will use data in TARS to assess and analyze the test results.

- Test Conductors and Test Analysts

The network test conductors and test analysts will use the TARS to store test data for future or real-time analysis. The test conductors will use TARS to develop comprehensive test results reports and analysis studies. The system will be used to transform test data into tabular, graphic, and narrative reports. Test analysis will be conducted using report output or through "on-screen" data display and manipulation.

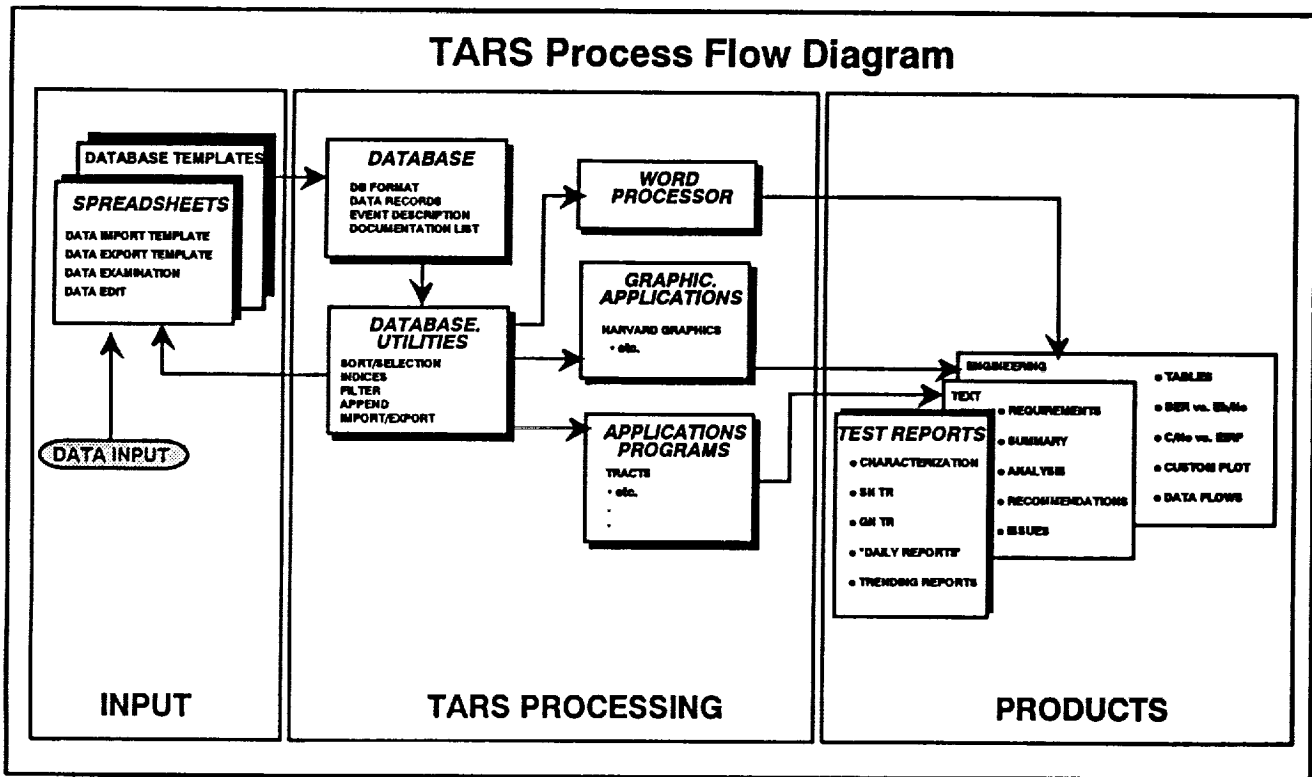
3.1.2.2 External User

The external users will use TARS primarily for test data retrieval, evaluation and analysis, and as planned, will use it for data input and test reporting. Network site personnel (i.e. NCC, WSC, GN, DSN sites, etc.) will eventually have the ability to access the TARS database directly via a site terminal and a modem. This system will enable test data input/archiving and will provide the site personnel with real-time access to test data, test analyses and reports, and it will enable accurate research and evaluation of previous test runs.

3.1.3 TARS Process Description

The following sections will describe the general structure of TARS describing it's components in terms of functionality and providing a general description of the specific products and applications. Figure 3.1.3 illustrates the TARS process flow.

FIGURE 3.1.3 THE TARS PROCESS FLOW



3.1.3.1 Data Input, Storage and Manipulation

Test Data is input to TARS through the use of either a spread sheet or directly via a database template. The compatible spreadsheets include Lotus 1-2-3, Quattro or Excell. These spreadsheet applications provide the framework for the entry and sorting of test data. Data import and export templates will be used to transfer the data from the spreadsheet to the database format. A database template will also be available directly to enter the data into the relational database. The TARS FoxPro database aids the user in insuring the accuracy of the data by checking the data characteristics (i.e. number of words, field type, decimal placement, maximum and minimum values, etc).

The system stores information in the form of data files. Although it is possible to organize the contents of data files in a wide variety of ways, it is important to note that TARS uses a relational database structure which resides on a LAN file server rather than a "flat" database. This relational database not only enables the user to store data but also to change, find (search, select), rearrange (sort, prioritize, categorize), analyze, and relate/compare data in the data base.

The relational database files within TARS will contain infinite sets of records. Each record will be further divided into fields that can hold various types of data. This type of data organization provides a table of information where the horizontal rows of the table represent the records and the vertical columns represent the fields. For example, the TARS application uses a relational database file to store the characteristic data of a particular test run. Each record in the file will contain various types of information for the particular test run and equipment/systems, while each field in the file contains the same type of information for all test runs. Figure 3.1.3.1 provides a typical example of a portion of a space network test data file.

Similar to the columns of a table or index, the fields can be of various lengths, and can hold various types of data. A TARS test data file typically contains fields representing dates, numeric values (ie. data rates, decibels, frequencies, channels, ratios), logical values (ie. True/False, Yes/No), and fields representing strings of characters such as test descriptions, resources titles, and analysis/evaluation statements. Like the rows of a table, each record has the same set of fields (although the contents of the field vary). The contents of the fields on a particular record, like the contents of a particular row on a table, are related to one another and this relationship is the origin of the term relational database.

FIGURE 3.1.3.1 THE TARS DATA FILE FORMAT (Sample)

SN Import / Export

F O R M A T	#	M	DD	YR	DOY	HH	MM	I BER	Q BER	C/No dB/Hz	PWR dBm	EIRP dBW	I dB	Q dB	Test Analysis & Retrieval System										SERVICE			WSGT= 0			POLARIZATION							
															TARS										KSA	A	0=FWD	RFSOC=3	1=LCP									
															DATA ENTRY & EXAMINATION TEMPLATE										SSA	I	1=RET	OTHER=9	SIGNAL	SOURCE	FREQ	DATA RATE						
															5/21/93										TDRS-6 Test					MA	A	I	M	D	D	D	MHz	KBPS
															# R G E										SSH	T	/	D	D	D	MHz	KBPS						
															1										KSA	1	2	1	0	15003.4	0	0	112500.000					

TDRS USED																																																																																																																																																																																																																																																																													
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3.1.3.2 Data Processing Techniques

In order to combine powerful functionality, flexibility, and easy assess, TARS was conceived in terms of shell programs and core programs. Shell programs, written in FoxPro language, provide access to main facilities of TARS including the following features:

- Menus and pop-up lists of available options
- Standard input screens and updating procedures
- Automated procedures to invoke core programs such as sort, select, filter, append, query and import/export.

Core programs invoke functions such as data analysis, and report writing. These programs read their data directly from files that the host FoxPro interpreter understands, and generates their results in the form of FoxPro files. As a result, most types of data manipulation - data input, modification, queries, simple reports - can be accomplished in FoxPro, which provides a particularly rich and open-ended set of commands with which to manipulate data. The use of the FoxPro application makes TARS a highly flexible and user-definable test analysis and test data retrieval system.

The TARS performs queries or searches on multiple parameters. These parameters include, but are not limited to, test dates, test data (for characterization tests), results of EIF testing (Go/No Go), test personnel/conductors, test location, test type, test levels, test issues/problems, and various data results.

3.1.3.3 Graphics Capabilities and Report Products

TARS will use several methods of graphics and report generation. The primary application to generate graphs of test data is Harvard Graphics. Typically a user will access TARS to "interrogate" the archived data; retrieve the pertinent historical test data based on the desired query, sort, and/or select criteria; and then import the data or files to his/her local system. Once the data is resident on the user's local system, he has the ability to generate graphics, charts, plots, etc. using the available graphic applications on his local system. In addition, reports and analysis text will be generated using standard word processor applications in conjunction with database ASCII files and tabular printouts.

The products which the TARS generates or facilitates will be associated with the life cycle of the integration and test process for a particular mission or system implementation. Typically, the system will generate data files, graphs, and text needed to create reports. The products may range from system trouble reports to weekly test reports to network test and result reports. The TARS will also be used to support various system analyses, studies and evaluations. Figure 3.1.1 above further illustrates some of the TARS products associated with the integration processes.

3.4 TARS Hardware Configuration

The TARS hardware configuration is a compilation of existing GSFC Code 531.4 resources and procured COTS hardware. The configuration consists of a local area network (LAN), work stations, a file server and access server, and modems.

The existing GSFC Code 531.4 10Base-T Ethernet LAN is in place and in use by test section NTMs, NCC test console and test analysis personnel. This LAN will be augmented to interconnect the TARS work stations and the TARS fileserver using Novell Netware software.

The TARS work stations will be configured with Microsoft DOS 5.0 or above, and Microsoft Windows 3.1. Figure 3.4. illustrates the minimum requirements for a typical TARS user terminal or work station.

FIGURE 3.4 THE TARS USER TERMINAL REQUIREMENTS

TARS WORKSTATION MINIMUM REQUIREMENTS	
<i>DOS PC</i>	<i>Macintosh</i>
386 SX	MAC PLUS
4 MB RAM	4 MB RAM
40 MB HARD DISK	40 MB HARD DISK
VGA MONITOR	VGA MONITOR
MOUSE	SYSTEM 7
ETHERNET CARD (INTERNAL USER)	ETHERNET CARD (INTERNAL USER)
MODEM (EXTERNAL USER)	MODEM (EXTERNAL USER)
WINDOWS 3.1	
DOS 5.0	

The file server is comprised of a full-height tower 486DX2/66 CPU with 286 KB - 25 nanoseconds of cache memory, and 16 MB - 60 nanoseconds of user RAM expandable to 32 MB. The server processor speed will be 500 to 550 MB SCSI 11 milliseconds. The server will also house a 1.0/2.0 GB DAT compatible tape drive with a software driver and backup application software for system routine and emergency backup capability.

4.0 Conclusion

The Test Analysis and Retrieval System (TARS) represents a major process improvement using the latest database technology, off-the-shelf equipments, and available efficiencies. This system will improve the access, archival, analysis, and reporting of the extensive and valuable data associated with the many Networks test and verification activities and processes. This system is a practical tool used to enhance the Networks data analysis and retrieval efficiency, effectiveness and productivity.

